RADON SURVEY IN METROPOLITAN TORONTO SCHOOLS

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ABSTRACT

The radon testing survey in Metropolitan Toronto public schools was the most intensive project of its kind ever undertaken in Canadian schools. It also included an extensive public education program on radiation and radon-in-schools.

The radon levels at 632 schools were measured using the CAIRS Radon Monitors . Ninety per cent of the locations measured were found to have a radon level equal to or less than 2 mWL. Two locations in two different schools were found to have a radon level at or above the Action Level (20 mWL). The remaining results were between the two extremes. Follow-up testing in those schools where more than 10 mWL of radon was found is in progress.

INTRODUCTION

Radon is produced by the radioactive disintegration of uranium which occurs naturally in soil and rocks. Radon gas moves through the earth and can seep into the air in buildings (1). It is well established (primarily through studies of uranium miners) that exposure to radon progeny may cause lung cancer (2).

CAIRS has screened all public schools in Metropolitan Toronto for radon. The project was carried out in two phases:

1. The initial phase was a pilot project conducted in 37 schools in early 1990. The purpose of this test was to check the screening procedures.

2. The purpose of the second phase, conducted in 1990-91, was to screen the remaining 595 schools and buildings.

In total, 2774 locations were tested for radon (3).

PROCEDURES

The intent of the initial screening was to determine if there were any high radon levels in a school. For this reason, rooms and areas that were likely to have elevated radon levels were selected. These included:

1. Basement classrooms

2. Occupied rooms which are isolated from the central ventilation system and in which only the room air is recirculated
3. Rooms on or near structural joints such as adjacent slabs
4. Rooms with a large floor/wall joint perimeter and appreciable gaps in this joint
5. Rooms that have floor slabs with significant cracks

After inspecting each school building and applying the above protocol, suitable locations for radon testing were identified and marked on the school floor plan.

CAIRS Radon Monitors, which are active alpha detectors, were delivered to each school in separate boxes. All monitors were numbered and labeled according to the Area Board of Education, school and monitoring location. The data tags were attached to the monitors.

About 700 school Chief Caretakers and other officials had education on radon-in- schools and were trained in procedures under the CAIRS public education program. The Chief Caretakers, following detailed instructions, placed the monitors at the designated locations on tables or shelves at a height of about 50-70 cm above floor level. As well, the monitors were placed away from radiators, hot air registers and draughty windows.

Testing was carried out during the winter when interior radon levels are generally higher. Because radon levels fluctuate, the monitors ran for seven days continuously to ensure a reliable average reading. At the end of the testing period, the monitors were returned to CAIRS for analysis.

QUALITY CONTROL

In order to maintain the quality of the testing program, various quality control measures were employed.

1. Inspection of Monitors

All monitors were inspected during the first or second day of the testing period in order to ensure that all the placement procedures were followed properly.

2. Duplicate Monitors

Duplicate monitors were placed side by side in one per cent of all locations monitored. These locations were selected randomly. The duplicate monitors were shipped, installed, stored, processed and analyzed under the same conditions as the primary monitors.

In 46% of these locations, both the primary and duplicate monitors produced exactly the same results. In the remaining cases the variation between the readings of the primary and duplicate monitors was very small.

3. Control Detectors

In order to determine the radon exposure that accumulated during the shipment and storage of monitors, twenty fresh detectors were selected as "field blanks". None of these detectors showed any reading above the lower limit of detection of the monitors.

4. Calibration

Monitors were calibrated regularly at the CAIRS Radon Calibration Facilities. Air flow measurements of the monitors were taken before and after the testing period. The air flow meter used in these measurements was also calibrated using a bubble tube and a stop watch.

THE CAIRS RADON MONITORS AND LABORATORY ANALYSIS

The CAIRS Radon Monitor is a Radon Progeny Integrating Sampling Unit.

The monitor head originally developed by the French Atomic Energy Commission (CEA) is, in essence, an alpha particle spectrometer capable of detecting separately the alpha particles from radon and thoron daughters (4). The alpha particles are detected by damage tracks they create on a film.

The films were etched chemically in 2.5 N NaOH solution at 60.0 C for 90 minutes inside a constant temperature bath. The tracks were counted using an image analysis system comprised of a Nikon camera, microscope and an Arteck counter. The data was fed into a computer and the radon levels were calculated.

The lower and upper limits of detection of the monitors are about 0.5 and 1,000 mWL respectively. The CAIRS Radon Monitor has passed Round 6 in the National Radon Proficiency Test of the U.S. Environmental Protection Agency.

RESULTS AND DISCUSSIONS

Table 1. Number of schools and locations monitored for radon

School Boards	Number of schools	Number of monitored locations
East York	28	102
Etobicoke	87	405
French Language	4	22
MTSB	9	28
North York	158	663
Scarborough	167	786
Toronto	142	598
York	37	170
Total	632	2,774

Table 1 shows the number of schools and the number of monitored locations in each of the eight school boards within Metropolitan Toronto.

Figure 1 illustrates the distribution of the number of locations monitored. On average about five locations were monitored in each school.

Figure 2 illustrates the distribution of radon levels at all locations monitored. 90% of locations monitored had a radon level equal to or less than 2 mWL.

Two schools were found with readings at or above the CAIRS recommended Action Level of 20 mWL. Three schools had readings

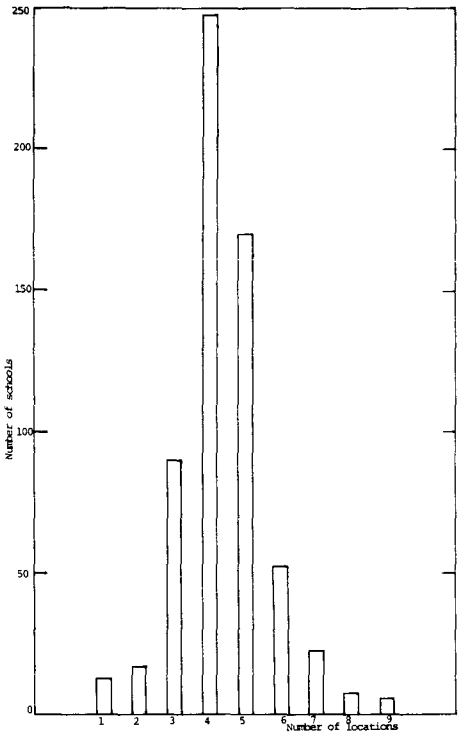

Figure 1. Distribution of the number of locations monitored.

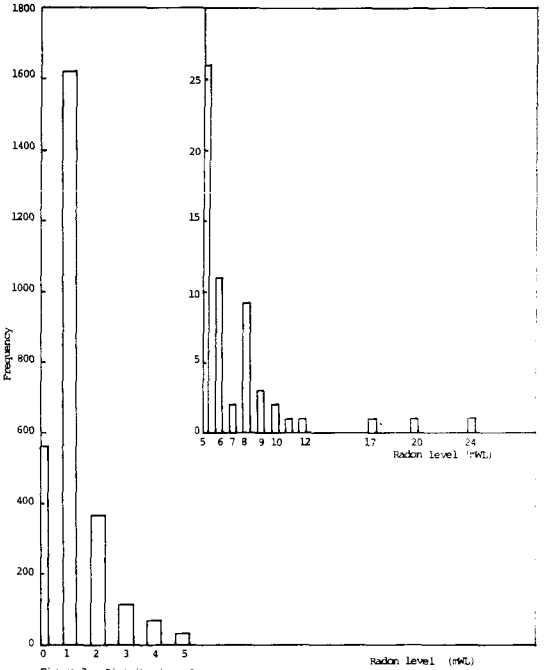

Figure 2. Distribution of radon levels at specific locations

at the intermediate level (10-20 mWL). (Follow-up testing in these schools is underway.) Apart from these elevated levels, the remaining locations demonstrated a radon level below the action level.

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